Urban Poverty and Infant Mortality Rate Disparities

Mario Sims, PhD; Tammy L. Sims, MD, MS; and Marino A. Bruce, PhD

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This study examined whether the relationship between high poverty and infant mortality rates (IMRs) varied across race- and ethnic-specific populations in large urban areas. Data were drawn from 1990 Census and 1992–1994 Vital Statistics for selected U.S. metropolitan areas. High-poverty areas were defined as neighborhoods in which ≥40% of the families had incomes below the federal poverty threshold. Bivariate models showed that high poverty was a significant predictor of IMR for each group; however, multivariate analyses demonstrate that maternal health and regional factors explained most of the variance in the group-specific models of IMR. Additional analysis revealed that high poverty was significantly associated with minority–white IMR disparities, and country of origin is an important consideration for ethnic birth outcomes. Findings from this study provide a glimpse into the complexity associated with infant mortality in metropolitan areas because they suggest that the factors associated with infant mortality in urban areas vary by race and ethnicity.

Key words: high poverty ■ infant mortality ■ racial disparities

© 2007. From the Department of Medicine, The Jackson Heart Study, University of Mississippi Medical Center, Jackson, MS (M. Sims); Department of Pediatrics, Center for Tobacco Research and Intervention, University of Wisconsin Medical School, Madison, WI (T. Sims); and Department of Family and Community Medicine, Meharry EXPORT Center for Health Disparities, Meharry Medical College, Nashville, TN (Bruce). Send correspondence and reprint requests for *J Natl Med Assoc.* 2007;99:349–356 to: Dr. Mario Sims, Department of Medicine, The Jackson Heart Study, University of Mississippi Medical Center, Jackson Medical Mall, Suite 701, 350 W. Woodrow Wilson Ave., Jackson, MS 39213; phone: (601) 368-4682; fax: (601) 368-4651; e-mail: msims2@medicine.umsmed.edu

INTRODUCTION

Infant mortality is a major concern for large urban areas in the United States. Many of the largest cities have infant mortality rates (number of infant deaths per 1,000 live births) that exceed the national average (6.63 deaths per 1,000 live births) and are places where considerable geographic, racial and ethnic infant outcome disparities persist.[1] Research has called for studies that focus on structural factors that create and maintain disadvantaged neighborhoods in U.S. urban centers in order to address health inequality among groups.[2,3] In recent years, epidemiologic research has called attention to the effects of ecology on health outcomes. These studies have found positive associations between residential segregation and infant and adult mortality,[4-7] community-level socioeconomic status (SES) and health and well-being,[8] neighborhood disadvantage and coronary heart disease,[9] and neighborhood income and postneonatal mortality.[10] These events are most detrimental for blacks, who are often segregated and concentrated in high-poverty neighborhoods. Thus, not only is a person's neighborhood a potential pathogen to illness[4] but also a pathway for exposures to illness and death.

While residential segregation and neighborhood income are crucial antecedents to adverse health conditions for African Americans, in particular, no study, to our knowledge, has examined the relationship between high poverty and infant mortality rates (IMRs). Coulton and Pandey,[11] however, found that among other factors, contiguity to high-poverty areas (where poor families live in areas with poverty rates >40%) had a significant impact on child health outcomes. Residents in high-poverty neighborhoods confront harsh social and economic conditions as well as stressors associated with a disadvantaged environment that are linked to poor health.[2] Living in such environments, for example, means that mothers likely lack the economic resources to obtain adequate prenatal care in order to ensure positive birth outcomes. This analysis examines the association between high poverty and IMR by race and ethnicity in selected large U.S. metropolitan areas. We use Vital Statistics and U.S. Census data from selected metropolitan areas to estimate race/ethnicity-specific models of IMRs that adjust for low birthweight (LBW),[12,13] teen birth rate,[14] alcohol use,[15] tobacco use[15,16] and region. The analyses make a contribution to health disparities research in two ways. First, this study uses an area socioeconomic position measure that gives some attention to the areas where many blacks and other disadvantaged groups live. Second, this study extends the discussion about race, class and health disparities beyond the "black–white paradigm" by showing how the relationship between high poverty and IMR varies between and within other (i. e., Latino and Asian) ethnic populations. This line of research paves a way for a more informed understanding of how severe deprivation impacts the life chances and quality of life for the youngest—and perhaps most vulnerable—segment of any population.

DATA AND METHODS

Data used in this analysis were drawn from two sources. The first source was the 1992, 1993 and 1994 Multiple-Cause-of-Death and Natality data files of the Vital Statistics, maintained by the National Center for Health Statistics.[17,18] The second data source was the 1990 U.S. Census STF3A block-group files.[19] Previous analyses have shown that using census data that are removed from primary data by a decade does not affect the regression results, as neighborhoods remain stable over time.[20] Census block groups (clusters of blocks that averaged 564 residents in 1990) represent the neighborhoods for which high-poverty percentages were calculated in a sample of 100 metropolitan statistical areas (MSAs–the unit of analysis). An MSA is a free-standing metropolitan area with a population size of ≥100,000. The census and Vital Statistics data were linked by common MSA codes found in each data file. The association of high poverty with IMR was examined for non-Hispanic blacks, non-Hispanic whites, Latinos and Asians. Among the 100 largest U.S. MSAs, the greatest number of MSAs for which IMR and poverty concentration could be analyzed was chosen for each race/ethnic group: 100 MSAs for blacks and whites, 60 MSAs for Latinos and 60 MSAs for Asians.

Measures

The dependent variable was the arithmetic mean of the area IMR for years spanning 1992–1994. The average of IMRs was used to decrease the instability that can be caused by rates for racial/ethnic groups in smaller MSAs. The primary independent variable (high poverty) was defined as the percentage of each race/ethnic group in MSAs who lived in block groups in which ≥40% of its residents had household incomes below the federal poverty threshold.[21]

Infant mortality has been found to be associated with a number of maternal risk factors, including LBW, teen birth rate, and alcohol and tobacco use. The LBW rate measure was the number of singleton infants born <2,500 g, or 5.5 lbs per 100 live births. The teen birth rate indicator was the number of births to unwed mothers aged 15–19 years old per 100 live births. Tobacco use was represented by the number of pregnant mothers who used tobacco (yes/no) per 100 live births. Alcohol use was the number of pregnant mothers who used alcohol (yes/no) per 100 live births. Each of these variables

Table 1. Descriptive characteristics of the sample population by race/ethnicity

	Blacks (N)	Whites (N)	Latinos (N)	Asians (N)
High Poverty[1]	12.6 (2,528,187)	0.5 (503,600)	6.4 (1,052,012)	1.5 (79,645)
Poverty	31.3 (6,267,507)	4.1 (4,235,120)	27.9 (4,601,638)	11.1 (592,614)
Nonpoverty	56.1 (11,258,876)	95.4 (98,529,833)	65.7 (10,817,027)	87.4 (4,669,826)
IMR[2]	17.0 (22,270)	6.5 (25,158)	8.6 (9,367)	5.9 (1,394)
Low Birthweight Rate[3]	13.5 (187,377)	6.2 (240,810)	7.0 (90,407)	6.7 (22,529)
Teen Birth Rate[4]	22.1 (282,408)	8.3 (296,597)	5.2 (230,085)	16.8 (15,268)
Tobacco Use[5]	13.4 (147,867)	15.0 (524,209)	3.1 (33,043)	7.3 (5,588)
Alcohol Use[6]	3.3 (35,852)	2.6 (80,181)	0.6 (6,117)	1.3 (698)
Racial Segregation[7]	64.8	44.1	43.2	
Region				
Northeast	23.4	26.5	19.8	20.9
Midwest	23.3	23.2	7.3	9.7
South	41.6	28.9	25.8	15.3
West	11.7	21.4	47.1	54.1

Source: 1990 U.S. Census Summary Tape File 3A series, and 1992, 1993 and 1994 Multiple-Cause-of-Death Mortality and Natality Files; 1: High-poverty neighborhoods have poverty rates of ≥40% in 1990; Poverty areas have poverty rates between 20–39.9% in 1990; and nonpoverty areas have poverty rates between 0–19% in 1990; 2: IMR: infant mortality rate—equals the death of an infant before its first birthday per 1,000 live births, averaged between 1992 and 1994; 3: Low birthweight rate equals births that are <2,500 g or 5.5 lbs per 100 live births, averaged between 1992 and 1994; 4: Teen birth rate equals the number of births to unmarried mothers age 15–19 years old per 100 live births, averaged between 1992 and 1994; 5: Tobacco use denotes the use of tobacco by pregnant women, averaged between 1992 and 1994; 6: Alcohol use indicates the use of alcohol by pregnant women, averaged between 1992 and 1994; 7: Racial residential segregation is defined by the index of dissimilarity (D) between each minority group and whites. Values of <30 are low, values between 30–60 are moderate, and those >60 are high (Kantrowitz[23]).

was calculated for each race/ethnic group at the MSA level and was averaged for the 1992, 1993 and 1994 periods. It is important to note that the tobacco use and alcohol use variables were highly correlated for black (r=0.80) and Latinos (r=0.78). Therefore, the black model contained the alcohol use variable and the Latino model contained the tobacco use variable. The correlation between alcohol and tobacco use was not an issue for whites and Asians; therefore, both measures were included in their respective regression models.

Research has found that such MSA-level controls as population size, racial residential segregation and region are important factors that are associated with IMR.[8,22] This study used MSA population size (logged) and region for the 1990 period. Segregation was defined by the index of dissimilarity (D) between each minority group and whites. Values of <30 were low, values between 30–60 were moderate, and those >60 were high.[23] For example, a value of 30 would indicate that either 30% of blacks or 30% of whites would have to

Figure 1. Association of minority–white IMR ratio with high poverty

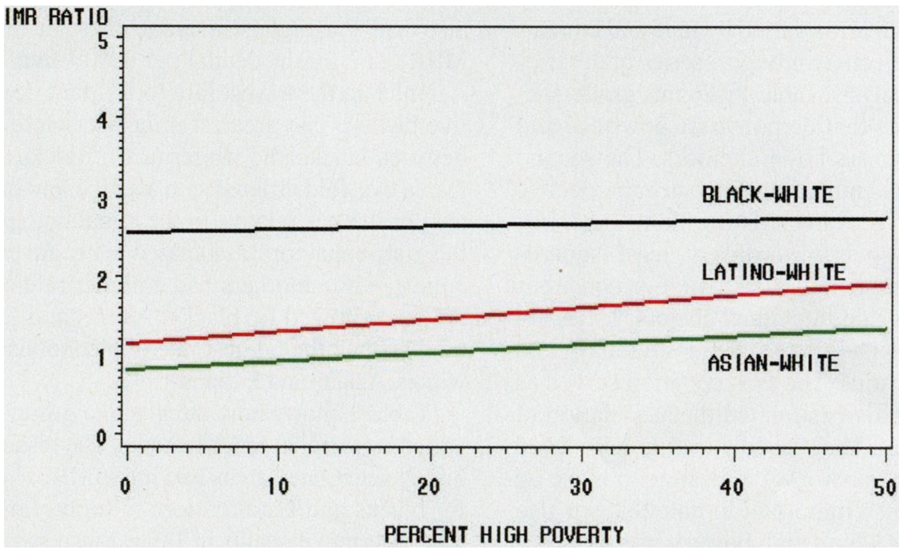


Table 2. Infant mortality rates by demographic characteristics for each racial and ethnic group in the 100 largest metropolitan statistical areas: 1990, 1992–1994

	Blacks	Whites	Latinos	Asians
Segregation				
High	17.0	–	8.7	–
Moderate	16.5	–	8.1	5.2
Low	–	–	5.7	–
MSA Population				
Largest	16.6	6.3	7.1	4.8
Bigger	16.2	6.2	7.6	5.1
Smaller	16.5	6.6	7.9	7.0
Smallest	18.1	7.1	9.8	5.1
Region				
Northeast	18.1	6.0	8.7	5.1
Midwest	18.3	7.1	10.2	6.5
South	15.2	6.6	6.7	5.1
West	17.0	6.6	7.2	4.8

Source: 1990 U.S. Census Summary Tape File 3A series, and 1992, 1993 and 1994 Multiple-Cause-of-Death Mortality and Natality files; 1: Each cell entry contains the average race/ethnic-specific infant mortality rate (IMR) for a category of the economic and demographic variables. For example, 17.0 in the first column for blacks means that in highly segregated (D>60) MSA in the sample, blacks have an average IMR of 17.0; 2: Segregation is defined by the index of dissimilarity (D) between each minority group and whites. Values of <30 are low, values between 30–60 are moderate, and those >60 are high (Kantrowitz[23]). For example, a value of 30 would indicate that either 30% of blacks or 30% of whites would have to exchange census blocks group neighborhoods to eliminate segregation between them; 3: Asians were only populated in moderately segregated (30<D<60) MSAs; 4: MSA is a metropolitan statistical area, which is a metropolitan area (minimum population of 100,000) with a large population nucleus (central city), together with adjacent communities (suburbs) that have a high degree of social and economic integration with that core. Each MSA was ranked by its total population size with 25 MSAs in four quartiles.

exchange census block group neighborhoods to eliminate segregation between them. Racial residential segregation was excluded from the analysis because it was highly correlated with high poverty. The extent to which a group lives in a high-poverty neighborhood is an indication of that group's residential segregation. Region was represented by dichotomous variables that denote four metropolitan regions (northeast, midwest, south and west) in the U.S. "West" was the omitted category.

Analytic Strategy

The objective of this study was to determine the extent to which the relationship between high poverty and IMR in large urban areas varied by race and ethnicity. We pursued this objective through a series of descriptive and regression analysis. Table 1 presents group-specific cross-tabulations that demonstrate how race and ethnic groups vary across key indicators. The second table presents results indicating how group-specific IMR varies across MSA characteristics. Table 3 presents results from group-specific ordinary least squares regression models. These models contain two equations showing how the area and individual characteristics are associated with IMR adjusting for individual- and MSA-level characteristics. The first equation served as the baseline model which estimated the association of high poverty with IMR. The second equation introduced individual-/health- and area-level indicators to make up the full model. It is also important to note that we also explored the extent to which high poverty was associated with minority–white IMR disparities (measured as the ratio between minority IMR and white IMR) and the relationship between high poverty and IMR for Latino and Asian subethnic groups. The results from these analyses are depicted in Figures 1–3. All analyses were performed using SPSS® version 11.5 for Windows®.

RESULTS

The results in Table 1 show that blacks are disadvantaged relative to other racial and ethnic groups in the study. Blacks had the highest percentages of families in high-poverty and poverty areas (12.6% and 31.3%, respectively) and were the group with the largest segment living in residentially segregated areas (65%). Blacks also had the highest average IMR in the 100 largest MSAs (17 infant deaths per 1,000 live births), while Asians had the lowest rate (5.9 infant deaths per 1,000 live births). The greatest minority–white disparity was between blacks and whites (2.6). Blacks also had more than a two-fold difference in average low-birthweight and teen birth rates relative to the remaining groups. Among the risk behaviors associated with adverse birth outcomes, white mothers had a higher rate of tobacco use (15.0), followed by blacks, Asians and Latinos. Black mothers had the highest rate of alcohol use, followed by whites, Asians and Latinos.

Table 2 shows how the average group-specific IMR varied by selected MSA features. The results indicate that highly segregated areas had high IMR. The highest IMR for blacks and Latinos were in high segregation areas. The descriptive results in Table 2 also suggest an inverse association between population size and IMR. The small-

Table 3. Unstandardized regression coefficients for the association of black, white, Latino and Asian infant mortality rates with high poverty in the 100 largest U.S. metropolitan statistical areas: 1990, 1992–1994

	Blacks		White		Latinos		Asians	
	Eq. 1	Eq. 2	Eq. 1	Eq. 2	Eq. 1	Eq. 2	Eq. 1	Eq. 2
High Poverty	0.09*	0.02	0.43*	0.17	0.09*	-0.05	0.11*	-0.17
Individual Level								
Low Birthweight	–	1.06***	–	0.11	–	0.05	–	-0.45
Teen Birth	–	-0.21	–	0.10*	–	0.27*	–	0.45
Alcohol Use	–	0.35	–	0.01	–	–	–	-2.97*
Tobacco Use	–	–	–	-0.01	–	0.20*	–	0.66
MSA Level								
MSA Size (log)	–	-0.62	–	0.03	–	-0.10	–	1.27
Region								
West								
Northeast	–	0.64	–	-0.21	–	0.40	–	3.17*
Midwest	–	2.80*	–	0.56*	–	1.27	–	2.10
South	–	-0.43	–	0.19	–	0.42	–	1.58
Intercept	15.7	13.9	6.39	4.60	7.34	2.73	4.88	-14.3
R2	0.05	0.32	0.07	0.36	0.07	0.47	0.09	0.46

Eq: equation; Source: 1990 U.S. Census Summary Tape File 3A series, and 1992, 1993 and 1994 Multiple-Cause-of-Death Mortality and Natality files; * p<0.05 *** p<0.001; 1: See footnote in Table 1 for definitions of each variable; Note: Race/ethnic-specific independent variables (except metro context measures) correspond to each race/ethnic-specific infant mortality rate. See Table 1 footnotes for definitions of each variable. Residential segregation was not estimated in the models due to its high correlation with percent high poverty (r>0.70).

est metropolitan area had the highest IMR for each group, as opposed to previous studies that found IMR was higher in larger places, mainly central cities.[4,6] Finally, Table 2 indicates that the midwest region of the United States had the highest IMR for each subpopulation.

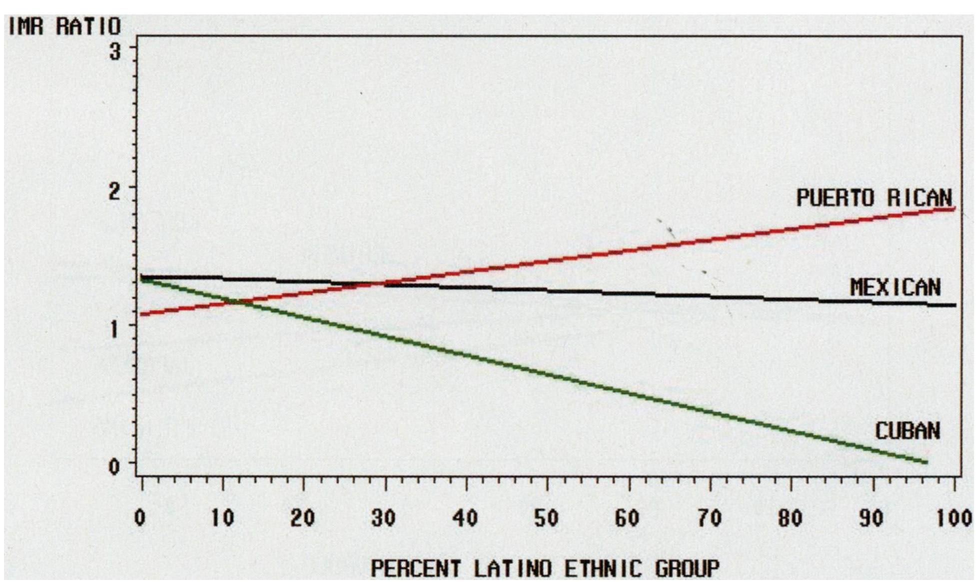
Table 3 reports the relationship between the independent variables and IMRs for race-specific subgroups in the largest MSAs in the United States. The bivariate model, represented by equation 1, indicates that high poverty ($p<0.05$) had a positive relationship with IMR. Areas with large segments of the population living below the poverty threshold had high IMRs. The full models in Table 3, represented by equation 2, indicate that the correlation between high poverty and IMR is affected significantly by the presence of health, population and regional factors. For example, the poverty coefficient for blacks shrinks by 78% once individual and area variables are introduced in equation 2. Table 3 shows that a similar pattern is present in the white, Latino and Asian models.

The results in Table 3 also indicate that the material and regional factors are related to IMR, but the specific relationships vary by race and ethnicity. LBW is found to be positively correlated for blacks, indicating that high LBW rates among black infants are associated with high IMR among this group. The teen birth coefficient is positive and significant in the white and Latino models. High birth rates among white and Latino teenagers are correlated with high IMR among each respective subpopulation. Tobacco use has a positive and statistically significant relationship with IMR in the Latino and Asian models, suggesting that a rise in the number of Latino and Asian smokers is related to an increase in their respective IMRs. Metropolitan region is found to be associated with the IMRs of all racial/ethnic groups except Latinos. Black and white midwesterners are found to have higher average IMRs than their respective counterparts living in the west. Asians living in the northeast have higher mean IMRs than Asians living the west. Asians are also distinctive because alcohol use is found to have an inverse relationship with IMR for this group. This finding contradicts existing research indicating alcohol use among mothers increases the likelihood of giving birth to an infant who dies before their first birthday. The negative relationship between alcohol use and IMR among Asians may be a statistical artifact that can be borne out with additional research.

Another component of this study examined the association of minority–white IMR disparities with high poverty (Figure 1). The minority–white IMR disparity was measured by the rate ratio. Two important findings from this analysis are depicted in Figure 1. First, the racial disparity in infant mortality was greatest between blacks and whites. Second, Figure 1 shows a positive relationship between high poverty and the minority–white disparities in IMRs. A rise in the proportion of groups living in high-poverty areas is related to an increase in the minority–white IMR disparities.

The Latino and Asian models of IMR are relatively robust. However, "Latino" and "Asian" are classifications that aggregative subethnic groups into two respective categories. For this reason, we disaggregate the Latino and Asian populations into pertinent subethnic groups to examine their associations with the overall Latino–white and Asian–white IMR disparities. Figure 2 reveals that the Latino–white IMR disparity increased the greatest extent as the percent Puerto Ricans in MSAs increased, while it declined the greatest extent as the percent Cubans increased. Figure 3 demonstrates that the Asian–white IMR disparity increased as the percent Chinese and Koreans increased. By contrast, the

Figure 2. Association of Latino–white IMR ratio with ethnicity



disparity declined as the percent Filipinos and Japanese increased.

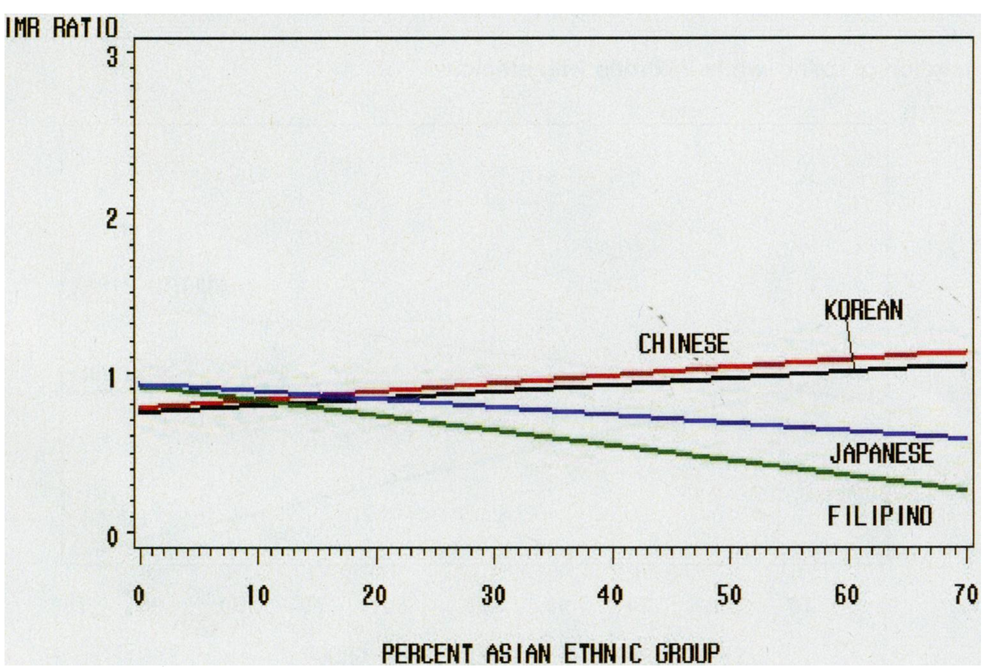
DISCUSSION

Reducing disparities in infant mortality levels is one of the goals emphasized in Healthy People 2010.[24] Paving inroads toward this goal requires researchers to focus on large urban areas. Recent reports by the Centers for Disease Control and Prevention cite that large urban areas are places where IMR and infant mortality disparities are a major health concern.[1] To this end, we use data from the 100 largest MSAs to explicate the relationship between race, ethnicity, extreme community deprivation and IMR in large urban areas. High poverty was positively associated with IMR in bivariate models; however, the correlation between high poverty and IMR was not statistically significant in the presence of individual- and MSA-level variables. The full models in Table 3 indicate that IMR has a direct association with LBW among blacks; teen birth rates among whites and Latinos; alcohol use among Asians; and tobacco use among Latinos; and region among blacks, white and Asians. These findings provide a glimpse into the complexity associated with infant mortality in metropolitan areas because they suggest that the factors associated with infant mortality in urban areas vary by race and ethnicity.

It is important to note that the null findings associated with high poverty in Table 3 do not definitively signify that area socioeconomic position is not important for understanding group-specific IMRs. It may be the case that the impact of poverty operates through other factors in the model. Research has demonstrated that poverty is correlated with LBW,[25,26] teen birth rate,[27] alcohol use[28] and tobacco use.[16] Furthermore, high poverty was shown to be associated with minority–white IMR disparities in Figure 1. As black–white, Latino–white and Asian–white IMR disparity increased, the percent each respective minority group lived in high poverty areas increased as well. This means that in order to reduce minority–white IMR disparities, the degree to which minorities (particularly blacks and Latinos) live in high-poverty neighborhoods should be in part considered. The concentration of minorities in high-poverty areas places them in jeopardy for experiencing negative economic and health conditions that contribute toward a broadening of economic as well as health disparities. It may be the case that the relationship between high poverty and IMR is indirect. Therefore, research investigating the relationship between area socioeconomic position and birth outcomes using alternative methodological frameworks and statistical techniques that allow for rigorous causal model specification (e.g., structural equation modeling) is warranted.

Our analysis of subethnic groups within the Latino and Asian populations suggests that country of origin is an important factor associated with community deprivation and infant mortality. The Latino–white IMR ratio increased as the Puerto-Rican population increased. Puerto Ricans are among the poorest subethnic group largely concentrated in poor urban areas in the northeast region.[29] Their poor economic conditions likely contribute to their poor health outcomes and, hence, elevated infant mortality. On the other hand, the Latino–white IMR disparity decreased as the Cuban population increased. Cubans are the most affluent subethnic group largely concentrated in Miami[30] and likely

Figure 3. Association of Asian–white IMR ratio with ethnicity



have the lowest IMR among the three groups. This reinforces studies that report more economic resources result in better health outcomes, while fewer resources result in poor health outcomes.[31]

Similarly, the Asian–white IMR ratio increased as the two lower-status groups (Koreans and Chinese) increased, while it decreased as the two more affluent groups (Japanese and Filipinos) increased. The two former populations have a greater proportion of recent immigrants who may lack the necessary economic resources and healthcare that may otherwise reduce IMRs as well as other adverse health conditions. To confirm these findings, research needs to further explore IMR disparities between Asian ethnic groups and whites. Though the Asian IMR was lower than the white IMR, the comparison of specific Asian subethnic groups and whites may prove otherwise.

This research is distinctive because it considers the association of ecology and health among four major racial and ethnic groups in the United States using group-specific analyses. Traditional epidemiologic research focusing on racial health disparities tends to use models of pooled samples that "adjust" or "control" for race with a racial composition variable (%black) or a race dummy variable (black=1). The results from this research present findings that provide a more nuanced understanding of health disparities. For example, the results in Table 3 indicate that infant health can be linked to the region in which parents live. The results suggest that it may be the case that black and white infants in the midwest and Asian infants in the northeast are exposed to greater health risks (e.g., lead paint, environmental toxins associated with heavy industry) than their counterparts in the west. Place matters, but the manner in which place matters can vary by race/ethnicity.

A second distinguishing feature of this research is that it goes beyond the "black–white" paradigm to include Latinos and Asians. Previous studies have only included black–white comparisons.[6,29] The growth of Latinos and Asians in the United States indicates that analyses of health disparities by race/ethnicity must include these groups. Native and immigrant segments of these populations will undoubtedly encounter adverse economic and residential conditions that will indirectly impact their health conditions.

This analysis is not without limitations. First, the models did not account for a number of factors thought to be associated with IMRs. Individuals living in high-poverty areas tend to be uninsured and have limited access to healthcare. Impoverished areas are less likely to have minority providers as well as services that cater to traditionally underserved populations. It also may be fruitful to consider noneconomic factors such as language, immigrant status and beliefs about prenatal care. A more complete examination of infant mortality is one that also considers cultural factors along with socioeconomic factors.

Second, central city may have been a more appropriate unit of measurement than MSA. A central city is the city with largest population in an MSA.[19] Typically, a central city contains a substantial segment of the high-poverty neighborhoods and minority population in a given MSA. In studies using MSA as the unit of analysis, poverty has been shown to have no significant association with IMR.[32] Whereas studies that use central city as the unit, poverty was a significant predictor of IMR.[22,33] The structure of the data did not allow us to estimate models for central cities, thereby limiting the robustness of the results.

Third, the data used in this analysis were not linked birth–infant–death data that match the deaths of mothers who experienced births. Linked birth–infant–death data however do not allow for MSA-level analyses of the influence of environment on health outcomes. This analysis hence used separate natality and mortality data that provided MSA codes, which permitted the simultaneous use of census and Vital Statistics data.

A fourth limitation is that census data are aggregated at the neighborhood and MSA levels, which means that individuals in the vital statistics data are not directly linked to high-poverty neighborhoods. Instead, associations between ecological and health variables are made at the MSA level. Thus, individual-level inferences cannot be drawn from these data.

CONCLUSION

This analysis offers some perspective beyond traditional individual-level determinants of infant health outcomes by examining the association of high poverty with IMR. Although high poverty did not have a statistically significant direct association with IMR over and above individual- and MSA-level factors, it was significantly associated with minority–white IMR disparities. Public health experts not only should focus on such maternal risk factors as LBW, teen birth and tobacco use to address group-specific IMR, but they may also want to consider the harmful effects high-poverty environments have on the minority–white IMR disparities.

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